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Dentofacial and upper airway characteristics of mild and severe Class II division 1 subjects

INAUGURAL-DISSERTATION

zur Erlangung der Doktorwürde der Zahnmedizin
der Medizinischen Fakultät
der Universität Zürich

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Genehmigt auf Antrag von Prof. Dr. med. dent. Th. Attin
Zürich 2010

Table of contents

1. Abstract

Aim: To assess whether mild and severe Class II division 1 subjects have craniofacial and upper airway characteristics, which relate to the severity of Class II as judged by overjet or ANB angle.

Material and Methods: The sample consisted of pre-treatment lateral cephalograms and dental casts of 131 males and 115 females (mean age 10.4±1.6). Inclusion criteria were: healthy Caucasian subjects, at least ¾ Class II first molar relationship on both sides and overjet ≥ 4 mm. The cephalograms were traced and digitized. Distances and angular values were computed. Mild and severe Class II were defined by overjet (<10mm / ≥10mm) or by ANB angle (<7° / ≥7°). Statistics were performed with two-sample t-test and Pearson's Rank Correlation analysis.

Results: In the two overjet groups significant differences were mainly found for incisor inclination while the two ANB groups differed significantly in SNA, WITS, Go-Pg, SpaSpp/MGo, SN/MGo and Ar-Gn. The shortest airway distance between the soft palate and the posterior pharyngeal wall was significantly correlated to the NS/Ar angle. Pearson's Rank Correlation analysis revealed several significant correlations of sagittal and vertical dimensions.

Conclusion: Patients with a large overjet or ANB angle differed significantly from patients with a small overjet or ANB angle mainly in their incisor inclination. In the present sample, the overjet and to some extent also the ANB angle is determined by soft tissue or individual tooth position rather than by skeletal background. In retrognatic patients, a tendency towards smaller airway dimensions was found, however, statistical analysis did not reveal a strong connection between upper airway and dentoskeletal parameters, but a large interindividual variation.

2. Introduction

Class II malocclusion with a particularly high prevalence (20-30%) in Caucasian populations (1-4) is a common orthodontic problem. Therefore its characteristics have been widely discussed in the literature (5-22). It is also evident that there is large interindividual variation in terms of craniofacial and dental morphology as well as severity of the Class II malocclusion (12, 13).

A retrognathic mandible (9, 23-28) because of deficient sagittal mandibular displacement (29-31) has been found to be an important trait in Class II occlusal development. Comparison of subjects with Class II malocclusion versus Class I occlusion, revealed an increased mandibular plane angle (30), smaller mandibular size (31) and increased vertical dimension (32) and face height (27) as typical features for Class II malocclusion.

The extent of sagittal discrepancy defines the severity of Class II malocclusion. Several parameters are used to assess the degree of deviation from the norm of skeletal, dental or the combination of both components. One of the measurements defining the severity is the overjet. In most orthodontic indices of treatment need or outcome, the overjet is considered as a major determinant of malocclusion severity (33-37). The general assumption is that the larger the overjet, the more severe a Class II would be and therefore also the need for orthodontic treatment more urgent. This assumption is supported by publications reporting an increased risk for upper incisor trauma with an increase in overjet (38, 39). The severity of the Class II also has an important influence on the treatment plan. It has been suggested that in subjects with an overjet greater than 10 mm, surgery may be the more successful treatment option than functional appliance treatment (40). Also in the widely used Index of Orthodontic Treatment Need (IOTN) (35) subjects with more than 9 mm overjet belong to the group with “very great” treatment need for orthodontic treatment (Grade 5). In the PAR index the overjet is also highly weighted (36, 37), but at the same time this index is for that reason particularly criticized (41). Difficulties in treatment do not only arise from a large overjet. Skeletal sagittal and vertical relationship, amount and direction of the remaining growth and inclination of the incisors usually play an important role in determining the complexity of treatment. From a skeletal perspective, the ANB angle is commonly used to describe Class II severity, even though points A and B are to some degree affected by incisor position (42).

Obstructive sleep apnoea patients with small pharyngeal airways tend to having features typical for Class II subjects, that is a short and retrognathic mandible (43) and sagittal discrepancy between the maxilla and mandible (44). Possible relationship between the severity of Class II and airway size, however, has not been adequately studied.

The aims of the present study were 1) to assess whether Class II division 1 subjects have other typical craniofacial characteristics, which relate to the severity of Class II as judged by overjet or ANB angle, 2) to study whether airway size correlates with Class II severity, 3) to study correlations in general between the skeletal, dental and airway measurements in the sagittal and vertical dimension.

3. Material and Methods

Material

The material consisted of pre-treatment lateral cephalograms, hand-wrist radiographs and dental casts. Inclusion criteria were: healthy subjects, Caucasian ethnicity, at least ¾ Class II first molar relationships on both sides (cusp-to-cusp cases were not included) and at least 4 mm overjet. The files of 246 growing subjects (131 males and 115 females), randomly selected from the archives at the Clinic for Orthodontics and Pediatric Dentistry of the University of Zurich, Switzerland met the selection criteria and represented Class II cases of varying severity with a wide range of overjet.

Methods

Lateral cephalograms had been taken with teeth in centric occlusion (CO) and with the Frankfort horizontal plane parallel to the floor. The position of the head was defined by ear rods and with a nasal support preventing the head from rotating during exposure. The focus-coronal plane distance was 200 cm, film-coronal plane distance was 15 cm and the enlargement was 7.5%. Only cephalograms of good quality were included.

The cephalogramms were hand-traced using a 0.5 mm lead on a 0.10 mm matte acetate tracing paper and then the landmarks were constructed (Figure 1) according to the definitions (Table 1). All tracings and landmark constructions were performed by the same person (JB). Another person (MS) verified all tracings and landmark definitions before digitizing. The digitizing was performed using tablet digitizer Numonics AccuGrid (Numonics, Landsdale, Pennsylvania, USA) with a resolution of 1 mili-Inch. The calculation of the cephalometric values according to the definitions was performed by self-written software. All values were corrected to the radiographic magnification of 7.5% before calculating to facilitate further comparison with the literature.

For assessment of the vertical and sagittal characteristics, distances and angular values in lateral cephalograms were computed; measurements are listed in Table 2.

The overjet and overbite were assessed on dental casts with an accuracy of 0.5 mm. In addition to the chronological age, the skeletal age was evaluated according to Greulich and Pyle (45) on hand-wrist radiographs. The skeletal age was assessed to eliminate bias caused by variation in growth timing.

Figure 1 Lateral cephalometric landmarks

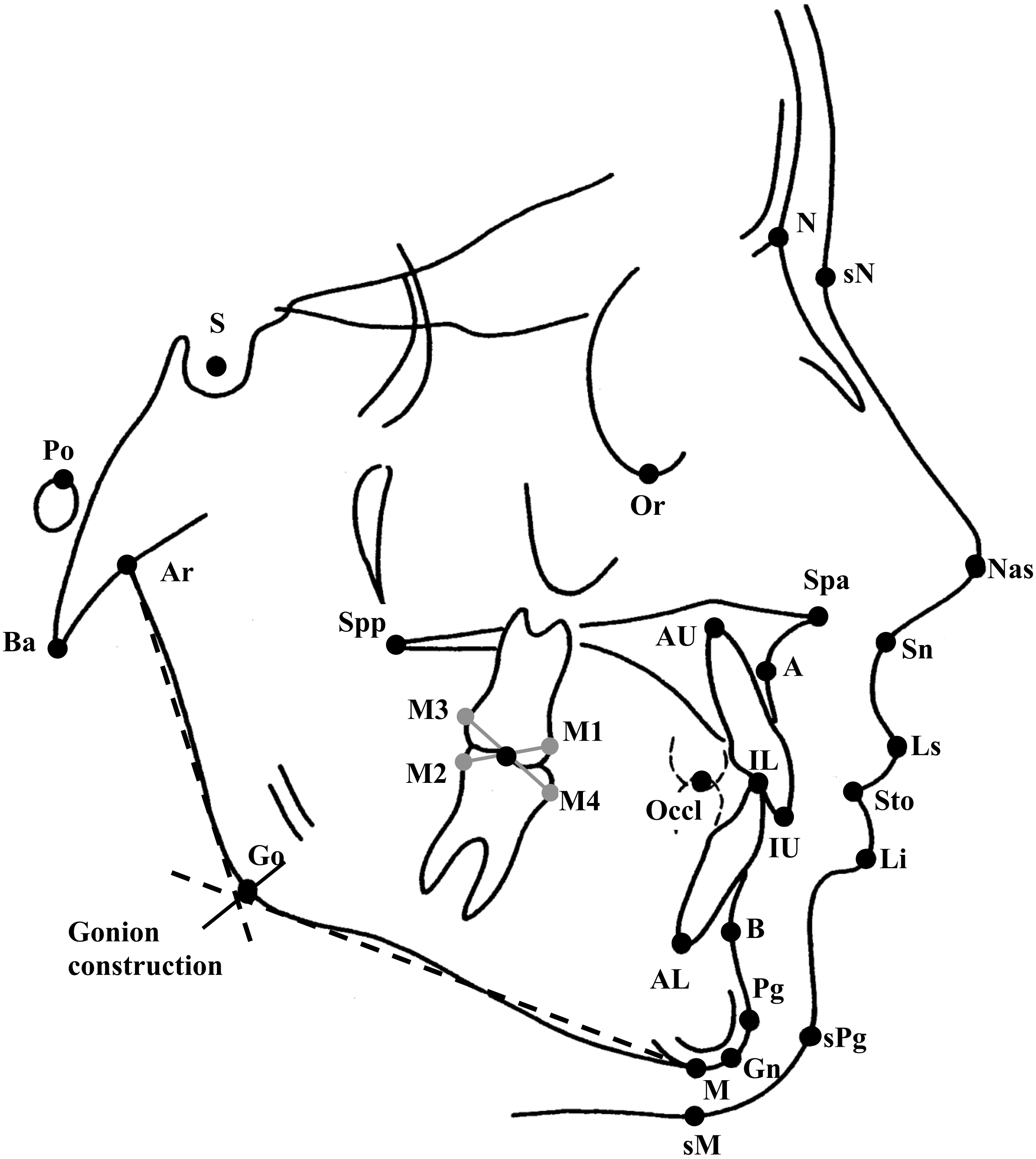


Table 1 Definition of the skeletal and dental landmarks in the lateral cephalometric analysis.

	Lateral Ceph landmark position and construction
Sella (S)	Centre of the Sella turcica. (Higley 1954)
Nasion (N)	Most anterior point of the Sutura nasofrontalis. (Downs 1948)
Spina nasalis anterior (Spa)	Most anterior point of the anterior nasal spine. (Sassouni 1971)
Spina nasalis posterior (Spp)	Projection of the most caudal point of the Fossa pterygopalatina onto the nasal floor. (Sassouni & Setareanos 1974)
Point A (A)	The deepest midline point on the premaxilla between the anterior nasal spine and prosthion. (Downs 1948)
Point B (B)	The deepest midline point on the mandible between infradentale and pogonion. (Downs 1948)
Menton (M)	Lowest point of the radiologic profile of the chin. (Jacobsen & Caufield 1985)
Gonion (Go)	Intersection of the angle bisector of the two mandibulary tangents through Articulare and Menton with the latero-basal contour of the mandible. (Jacobsen & Caufield 1985)
Occlusale (Occ)	Centre of the overlap of the first premolar or deciduous molar from the upper and lower jaw. As the anterior point defining the occlusal plane it was decided not to use the overlap of the canines. With Class II division 1, incisors and canines of the lower jaw often elongate. For better representation of the inclination of the occlusal plane, it was decided to use the overlap of the deciduous molars or the first premolars. (University of Zürich)
Molar point 1 (M1)	The most mesial point of the upper first molars. (University of Zürich)
Molar point 2 (M2)	The most distal point of the lower first molars. (University of Zürich)
Molar point 3 (M3)	The most distal point of the upper first molars. (University of Zürich)
Molar point 4 (M4)	The most mesial point of the lower first molars. (University of Zürich)
Orbitale (Or)	Lowest point of the infraorbital margin. (Björk 1947)
Porion (Po)	Highest point on the upper margin of the porus acusticus externus. (Ricketts 1960)
Articulare (Ar)	Point of Intersection of the dorsal contours of process articularis mandibulae and os temporale. (Björk 1947)
Basion (Ba)	Most caudal point of the Clivus. (University of Zürich)

Pogonion (Pg)	Most prominent point of the chin / on the symphysis of the mandible. (Jacobsen & Caufield 1985)
Menton (M)	Lowest point of the contour of the mandibular symphysis. (Jacobsen & Caufield 1985)
Gnathion (Gn)	Midpoint between Pogonion and Menton on the ventral mandibular symphysis. (Jacobsen & Caufield 1985)
Upper incisor apex (AU)	Root tip of the most anterior maxillary central incisor. (Bhatia & Leighton 1993)
Upper incisor incision (IU)	Incisal tip of the most anterior maxillary central incisor. (Björk 1947)
Lower incisor apex (AL)	Root tip of the most anterior mandibular central incisor. (Bhatia & Leighton 1993)
Lower incisor incision (IL)	Incisal tip of the most anterior mandibular central incisor. (Björk 1960)
Soft Nasion (sN)	Deepest point on the concavity overlaying the area of the frontonasal suture. (University of Zürich)
Nasale (Nas)	Most prominent point of the nose tip. (University of Zürich)
Subnasale (Sn)	Deepest point on the concavity between the nasal septum and the upper lip. (University of Zürich)
Labrale Superius (Ls)	Most anterior point of the upper lip. (University of Zürich)
Labrale Inferius (Li)	Most anterior point of the lower lip. (University of Zürich)
Stomion (Sto)	Most anterior contact point between upper and lower lip. (Chaconas 1980)
Soft Pogonion (sPg)	Most prominent point of the soft tissue chin. (University of Zürich)
Soft Menton (sM)	Lowest point of the soft tissue chin. (University of Zürich)

Error of method

To assess the method error 31 randomly selected lateral radiographs were retraced again by the same person (JB). Again, another person (MS) verified all tracings and landmark definitions before digitizing. The combined error of landmark location, tracing and digitation was determined using Interclass Correlation Coefficient (ICC).

Statistical Method

Statistical analyses were performed using Statistical Package for the Social Sciences 17.0.0 for Windows (SPSS Inc, Chicago, Illinois, USA). Descriptive statistics were calculated for all measurements.

The 246 growing subjects were divided in two groups using the ANB angle (1st Group: ANB < 7 º, 2nd Group ANB ≥ 7 º) and the overjet (1st Group: overjet < 10 mm, 2nd Group: overjet ≥ 10 mm) based on criteria of the Swiss national insurance for birth defects. Statistical comparison of the ANB and overjet groups with other cephalometric variables was performed with unpaired two-sample t-test.

In order to analyse the degree of association between two continuous variables, scatterplots and Pearson's Rank Correlation analysis were used. Results having a P value below 0.05 were considered statistically significant.

Pre-hoc power analysis

The purpose of the pre-hoc power analysis was to test the null hypothesis that the correlation in the population is 0.00 while the significance for clinical relevance has been set at 0.05. With the current sample size of 246 the study has power of 95 % to yield a statistically significant correlation with a correlation coefficient of at least 0.230 (95 % CI 0.134-0.685).

Table 2 Measurements in lateral cephalometric analysis.

Angular skeletal measurements
Sagittal angular measurements
ANB
SNA
SNB
FH/N-Pg
NS/Ar
MGo/Ar
SN/Pg
NS/Gn
Vertical angular measurements
SpaSpp/MGo
SN/MGo
SN/FH
SN/SpaSpp
FH/SpaSpp
FH/MGo
FH/Occ
Linear skeletal measurements
Sagittal linear measurements
A-NPg
S-N
Go-Pg
Go-Me
S-Ba
Ar-Gn
Spp-A
Spa-Spp
Vertical linear measurements
S-Go
N-M
Ar-Go
% S-Go:N-M

Angular and linear dentoskeletal measurements	
Angular measurements	
+1/FH	
+1/SpaSpp	
-1/FH	
-1/MGo	
+1/-1	
Linear measurements	
+1-NA	
-1-NB	
Pg-NB	
H-Diff	
Airway measurements (linear measurements)	
p	The shortest distance between the soft palate and the posterior pharyngeal wall
t	The shortest distance between the tongue and the posterior pharyngeal wall

4. Results

Repeatability

Repeatability study for lateral cephalometric measurements revealed the mean Interclass Correlation Coefficient to be 98.1 % (median 99.4 %, range 94.4 % - 99.9 %), which indicates excellent repeatability of measurements.

Correlation Analysis

Table 3 and 4 relate to comparison of the two overjet and ANB groups. Statistically significant differences for +1/SpaSpp, -1/MGo and Spa-Spp were found between the overjet groups. Significant differences for SNA, WITS, Go-Pg, SpaSpp/MGo, SN/MGo and Ar-Gn were detected between the ANB groups. No differences were found concerning the overjet or SNB for the different ANB severity groups. The same was true for ANB or SNB in the different overjet severity groups.

Table 3 Unpaired two-sample t-test for two overjet groups (<10mm / ≥10mm)

n (=246)	160 (< 10)	86 (≥ 10)	Significance
Chronologic Age	10.42±1.58	10.44±1.60	0.841
Skeletal Age	10.08±1.84	9.87±1.83	0.660
Overbite (mm)	3.77±2.32	3.99±2.48	0.483
SNA (°)	80.06±3.86	79.57±3.41	0.325
SNB (°)	74.44±3.59	73.75±3.17	0.137
ANB (°)	5.62±1.73	5.82±1.82	0.396
WITS	3.14±2.69	3.29±2.42	0.693
Go-Pg	71.98±4.87	70.93±4.70	0.103
SpaSpp/MGo (°)	29.02±4.96	28.98±4.71	0.957
SN/MGo (°)	35.44±5.33	35.40±5.14	0.961
+1/SpaSpp (°)	111.36±6.79	116.39±7.27	**0.000****
-1/MGo (°)	96.66±6.84	93.68±6.73	**0.001****
Spa-Spp	55.54±3.55	54.52±2.71	**0.021***
S-Go	70.86±5.36	70.16±4.97	0.317
N-M	113.06±7.37	111.86±6.15	0.199
Ar-Go	41.13±3.94	40.52±3.60	0.228
Ar-Gn	101.38±6.21	99.62±5.38	0.027
Airway distance "t"	10.82±3.64	10.37±3.63	0.361
Airway distance "p"	9.33±2.94	8.90±2.95	0.279
SNBa (°)	131.15±4.82	130.83±4.64	0.624

**Correlation is significant at the 0.001 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed)

Table 4 Unpaired two-sample t-test ANB (<7º / ≥7º)

n (=246)	198 (< 7º)	48 (≥ 7º)	Significance
Chronologic Age	10.13±1.58	10.50±1.57	0.546
Skeletal Age	10.03±1.89	9.89±1.59	0.478
Overjet (mm)	8.46±2.32	8.98±2.38	0.164
Overbite (mm)	3.85±2.36	3.82±2.43	0.936
SNA (°)	79.32±3.49	82.19±3.73	**0.000****
SNB (°)	74.25±3.43	73.95±3.62	0.592
WITS	2.88±2.45	4.45±2.82	**0.000****
Go-Pg	72.09±4.75	69.68±4.71	**0.002***
SpaSpp/MGo (°)	28.51±4.83	31.07±4.50	**0.001****
SN/MGo (°)	34.91±5.28	37.53±4.64	**0.002***
+1/SpaSpp (°)	113.43±7.28	111.87±7.63	0.192
-1/MGo (°)	95.20±6.61	97.33±8.00	0.056
Spa-Spp	54.99±3.32	55.96±3.22	0.070
S-Go	70.91±5.26	69.39±4.98	0.071
N-M	112.61±7.27	112.78±5.69	0.877
Ar-Go	41.11±3.86	40.26±3.65	0.185
Ar-Gn	101.22±5.99	98.88±5.59	**0.014***
Airway distance “t”	10.65±3.59	10.71±3.86	0.921
Airway distance “p”	9.29±2.92	8.74±3.05	0.244
SNBa (°)	131.00±4.66	131.19±5.16	0.798

**Correlation is significant at the 0.001 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed)

For the airway measurements, the only significant correlation for the distance “p” (the smallest distance between the soft palate and the posterior pharyngeal wall) was found with the NS/Ar angle (P≤ 0.021, correlation coefficient (cc)= 0.148). For the distance “t” (the smallest distance between the tongue and the posterior pharyngeal wall) a positive correlation was found to a ratio between the length of the cranial base and the length to Point A (measured parallel to FH, perpendicularly to a line through Point S) (P≤ 0.003, cc = 0.191) and the length to Point B (P≤ 0.017, cc = 0.152). No other significant correlations were detected.

Pearson’s Rank Correlation analysis (parametric) and scatterplots revealed several statistically significant correlations of vertical measurements with sagittal, dental and linear measurements (Table 5). SpaSpp/MGo angle had a highly significant correlation with the overbite (P≤ 0.001, cc = -0.259), SNA angle (P≤ 0.001, cc = -0.294), SNB angle (P≤ 0.001, cc = -0.419) and SN/Pg angle (P ≤ 0.001, cc = -0.523) and a weaker correlation with the ANB angle (P= 0.001, cc = 0.204). The measurements for SpaSpp/MGo angle in correlation to the angle between +1/SpaSpp and -1/MGo showed also a significant negative correlation (P≤ 0.001, cc = -0.266 and -0.367). For the SpaSpp/MGo angle and the distance between Ar-Go (P ≤ 0.001, cc = -0.463) a highly significant correlation was found and slightly less significant correlation with the distance between Go-Pg (P= 0.001, cc = -0.201). (Figure A)

The SN/MGo angle showed a statistically high significant correlation with SN/SpaSpp (P≤ 0.000, cc = 0.399), SNA (P≤ 0.001, cc = -0.516), SNB (P≤ 0.001, cc = -0.685) and ANB (P≤ 0.001, cc = 0.259).

Also highly significant correlations were detected for the SN/MGo and angles between +1/SpaSpp and -1/MGo (P≤ 0.001, cc = -0.234 and -0.367). (Figure B)

The NS/Ar angle has a highly significant correlation with the SNA and SNB angle respectively (P≤ 0.001, cc = -0.419 and -0.430). (Figure C)

For the gonial angle (MGo/Ar) and the distances Ar-Go and Go-Pg there were significant negative correlations (P≤ 0.001, cc = -0.335 and -0.326). Also for the gonial and SpaSpp/MGo angles respectively -1/MGo there are statistically significant correlations (P≤ 0.001, cc = 0.554 and -0.340). (Figure D)

No statistically significant correlation was found between the ANB angle and the overjet using Pearson’s Rank Correlation analysis (P= 0.072, cc = 0.262). (Figure E)

Table 5 Results of Pearson's Rank Correlation analysis.

			Intermaxillary divergence (SpaSpp/MGo)	**Vertical divergence (SN/MGo)**	**Sagittal divergence (NS/Ar)**	**Gonion angle (MGo/Ar)**
Sagittal values	**SNA**	**Coefficient**	***-0.294***	***-0.516***	***-0.419***	-0.049
		P value	***0.000***	***0.000***	***0.000***	0.451
	SNB	**Coefficient**	***-0.419***	***-0.685***	***-0.430***	-0.155
		P value	***0.000***	***0.000***	***0.000***	0.016
	ANB	**Coefficient**	***0.204****	***0.259***	-0.039	***0.179****
		P value	***0.001***	***0.000***	0.549	***0.005***
	SN/Pg	**Coefficient**	***-0.523***	-0.763	-0.336	-0.233
		P value	***0.000***	0.000	0.000	0.000
	Go-Pg	**Coefficient**	***-0.201****	-0.271	0.093	***-0.326***
		P value	***0.001***	0.000	0.151	***0.000***
Vertical values	**Overbite**	**Coefficient**	***-0.259***	-0.209	0.040	-0.055
		P value	***0.000***	0.001	0.540	0.396
	Ar-Go	**Coefficient**	***-0.463***	-0.508	0.221	***-0.335***
		P value	***0.000***	0.000	0.001	***0.000***
	SN/SpaSpp	**Coefficient**	***-0.138****	***0.399***	0.367	0.094
		P value	***0.031***	***0.000***	0.000	0.144
	SpaSpp/MGo	**Coefficient**	---	0.841	-0.043	***0.554***
		P value	---	0.000	0.503	***0.000***
Dental values	**+1/SpaSpp**	**Coefficient**	***-0.266***	***-0.234***	-0.100	-0.115
		P value	***0.000***	***0.000***	0.121	0.075
	-1/MGo	**Coefficint**	***-0.367***	***-0.367***	0.149	***-0.340***
		P value	***0.000***	***0.000***	0.021	***0.000***

**Correlation is significant at the 0.001 level (2-tailed).
*Correlation is significant at the 0.010 level (2-tailed)

Figure A Scatterplots of the correlation between SpaSpp/MGo and sagittal, vertical linear and dental measurements.

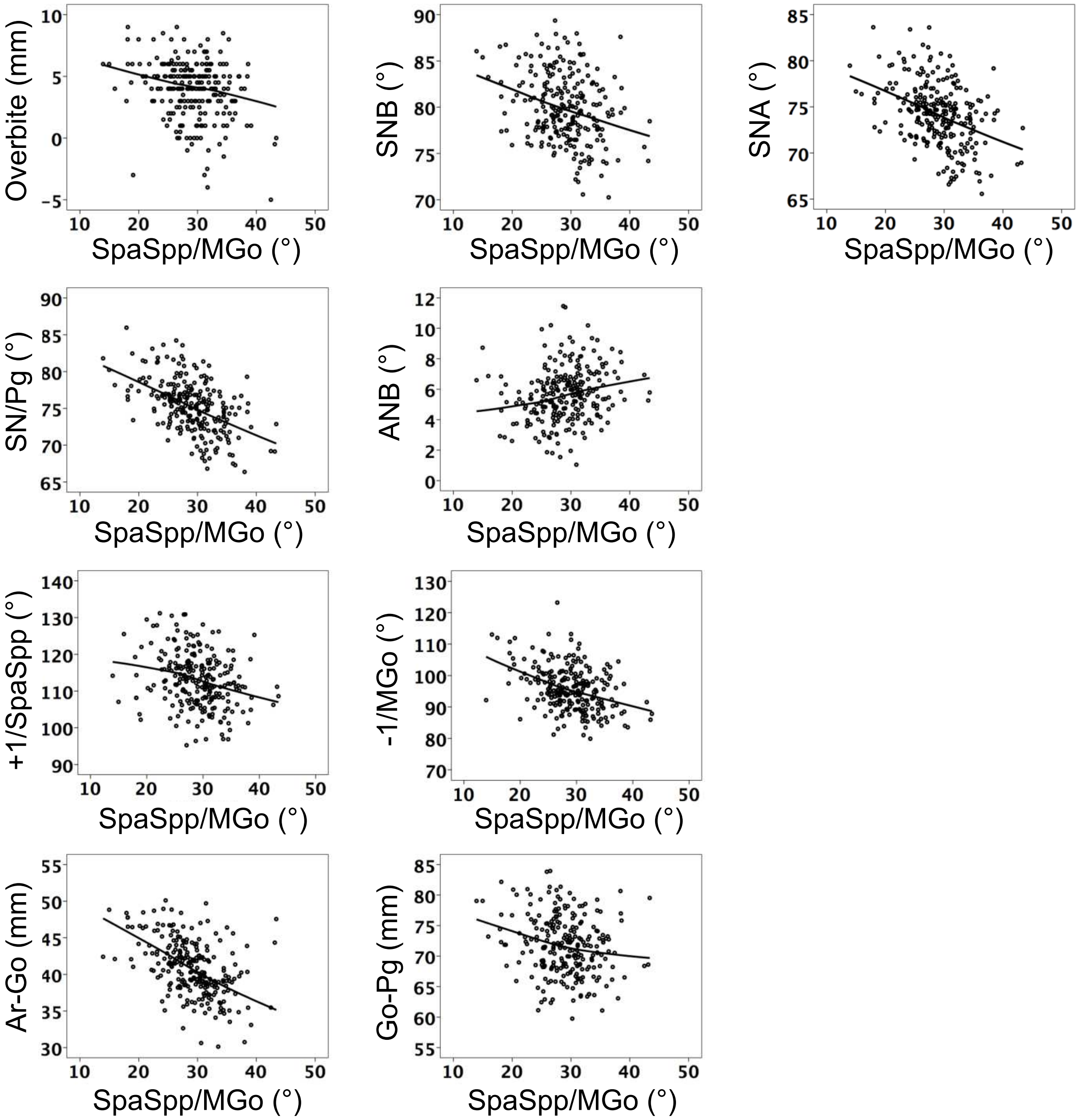


Figure B Scatterplots of the correlation between SN/MGo and sagittal, vertical and dental measurements.

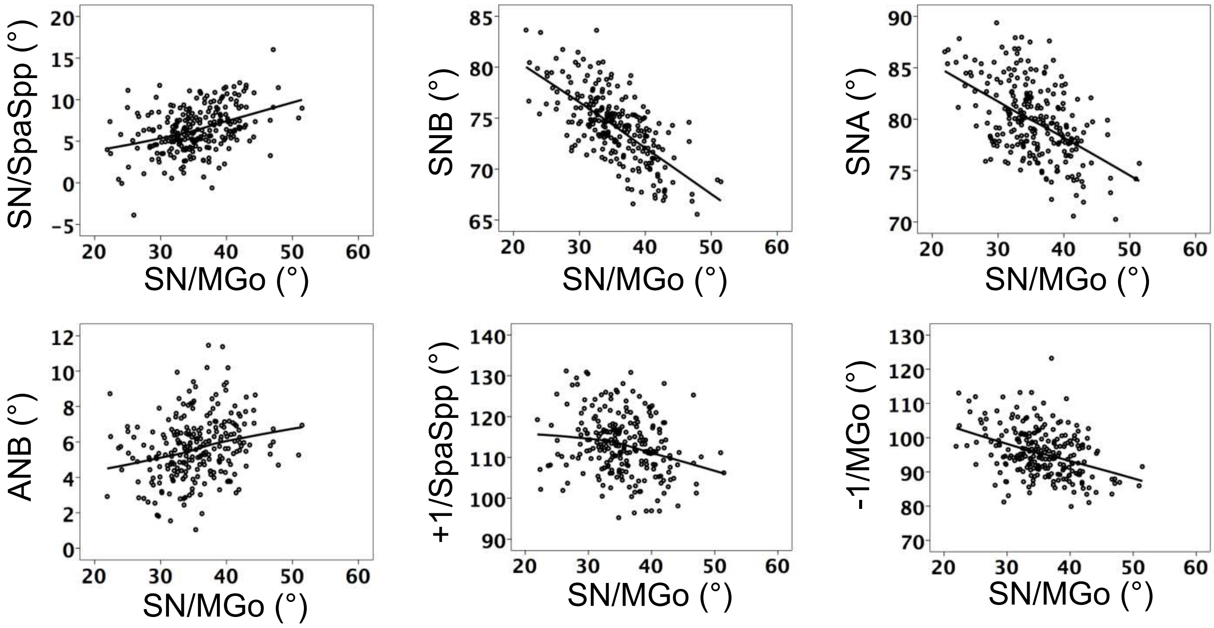


Figure C Scatterplots of the correlation between NS/Ar and sagittal measurements.

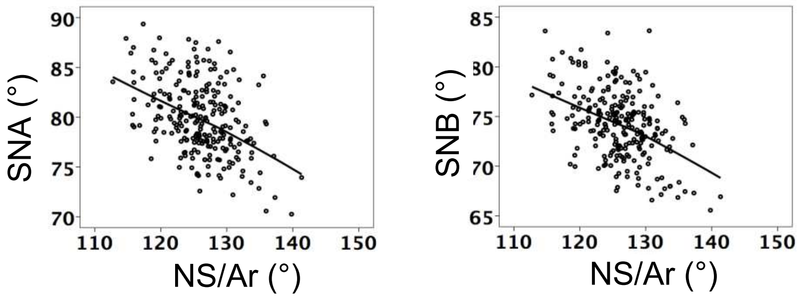


Figure D Scatterplots of the correlation between MGo/Ar and sagittal, vertical, linear and dental measurements.

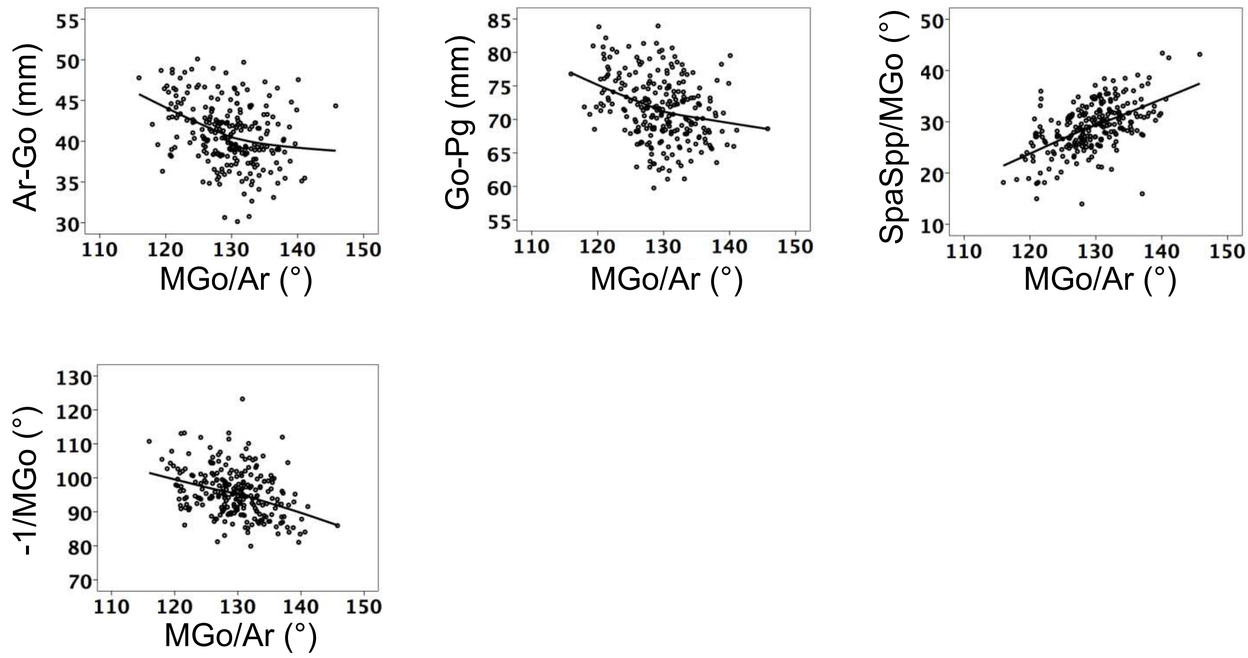
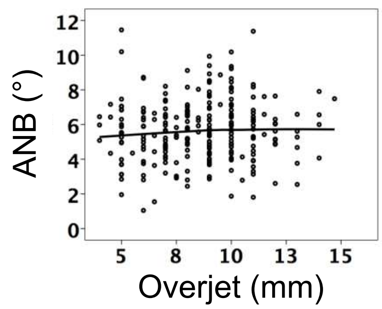


Figure E Scatterplots of the correlation between ANB Angle and Overjet.



5. Discussion

Due to the high prevalence of Class II division 1 malocclusion, its characteristics are extensively discussed in the literature. Cross-sectional studies usually compare Class II individuals to either a group with Class I occlusion, or to existing cephalometric standards but not to cases differing for Class II severity (5-8, 10-12). Therefore, the aim was to study whether overjet or ANB angle really allow for differentiation as to the severity of Class II in individuals with malocclusion.

It was found that the primary statistically significant difference between Class II patients with a large overjet (≥ 10 mm) as compared to patients with a small overjet lay in their incisor inclination. Remarkably, the only statistically significant skeletal difference was the length of the upper jaw. Therefore it seems that the overjet is rather determined by the function of the soft tissue or by individual tooth position than by the underlying skeleton. Lower lip interposition under the upper incisors, often in combination with forced lip closure and a deep labiomental fold, is a common finding in Class II malocclusion subjects with increased overjet (50). For example, one might presume that lower lip interposition between the upper and lower incisors, or lower lip sucking habits were more frequent in the large overjet group than in the smaller overjet group. Such lip pressure leads to more proclined upper incisors and retroclined lower incisors, thereby increasing the overjet beyond the underlying skeletal discrepancy (46, 47).

Concerning differences between the ANB groups (< 7 ° / ≥ 7 °) as expected the SNA angle was significantly greater in the group with the higher Class II severity. This difference in SNA can also be partially explained by the degree of the upper incisor inclination since the position of point A can be altered to some extent by the position of the roots of the upper first incisors (42, 48).

Surprisingly, there was no difference regarding SNB in our sample. There were however significant differences in the configuration and length of the lower jaw.

As expected, the SNB angle is an important discriminator between various degrees of class II severity in other studies (21). In this sample, dental inclination and soft tissue function obviously played a more important role, probably because the files represented different degrees of Class II severity with a wide range of overjet according to plaster models, rather than different skeletal patterns on lateral radiographs.

In the present sample there was a statistically significant correlation between the gonial angle (MGo/Ar) and the length of the horizontal (Go-Pg) and the vertical (Go-Ar) part of the mandible. A large gonial angle (MGo/Ar) correlates with a smaller horizontal and vertical dimension of the mandibular body and with a wider angle between SpaSpp/MGo.

Correlations to the measured minimal airway distances were in general quite weak. Contrary to expectation, correlations to SNA, SNB, ANB, overjet or any vertical dimension could not be found. However, there was a tendency in retrognatic patients towards smaller airway dimensions. One explanation might be that not the absolute length of the jaws but rather their position relative to the cranial base might be important for the size of the airway. Therefore it is not surprising that a negative correlation for SN/Ar was not only found for the SNA and SNB angle, but also for the upper airway dimension.

However, in general it seems that the size of the airway shows wide interindividual variation and is generally quite independent of the skeletal parameters. An explanation for this could be that among individuals with a small airway there is an overlapping between those that have a small airway because of their abnormal skeletal structure and those that have normal craniofacial structures but are obese, have excessive soft tissue thickness or reduced airway dilator muscle activity (49).

The group with higher ANB values had a more vertical skeletal pattern. In our sample the intermaxillary divergence (SpaSpp/MGo) correlates statistically significant with SNA, SNB and SN/Pg angles and to a lesser degree but also statistically significant with the ANB angle. This would be logical if we assume only a certain measure of growth potential for the upper and lower jaw. An increased vertical development would then lead to a limitation of sagittal growth and anterior displacement of the upper and lower jaw at the end of growth. Increased vertical growth leads to posterior rotation of the mandible in relation to the cranial base, resulting in a downward and backward displacement of the chin.

There were significant negative correlations between the SpaSpp/MGo angle, and the SN/MGo angle to the -1/MGo angle and the +1/SpaSpp angle respectively. Correlation between the vertical dimension and the position of the lower anterior teeth is supposedly of an adaptive nature to maintain a functional overbite and ensure masticatory function, or through the influence of the surrounding soft tissues. In a posterior growth pattern of the lower jaw within the surrounding soft tissues, the lower incisors are more likely to be pushed into the lower lip because of the backward and downward rotation of the chin. Consequently, the lower anterior teeth are more likely to be influenced by the lip pressure, resulting in a lingually directed force on those teeth during forced lip closure. At the same time occlusal forces might also cause a reclined position of the lower incisors. A large gonial angle (MGo/Ar angle) and intermaxillary divergence (SpaSpp/MGo angle) are correlating to a statistically significant degree with more retrusion of the lower anterior teeth relative to the mandibular base (-1/MGo angle).

A statistically significant negative correlation was found between the angle SpaSpp/MGo and the overbite. Contrary to the statistically significant correlation between the Overbite and the intermaxillary divergence (SpaSpp/MGo), the overjet and the ANB angle did not show a statistically significant correlation.

6. Conclusion

Overjet, often the first clinical impression of Class II severity, is not necessarily an adequate parameter for determining the true (skeletal) severity of a Class II malocclusion. The overjet is more likely to be influenced by functional factors such as the lips or tongue than by skeletal factors.

In general, the difference between low severity and high severity Class II patients and their treatment challenges is revealed far more accurately by the gonial angle of the mandible, the vertical dimension, growth pattern and the position of the jaws in relation to the cranial base than by the overjet.

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